Gravity corrections available (T54a)

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The INTREPID Gravity tool can calculate individual gravity corrections or gravity anomalies for a gravity point dataset. It creates new fields to store these values.

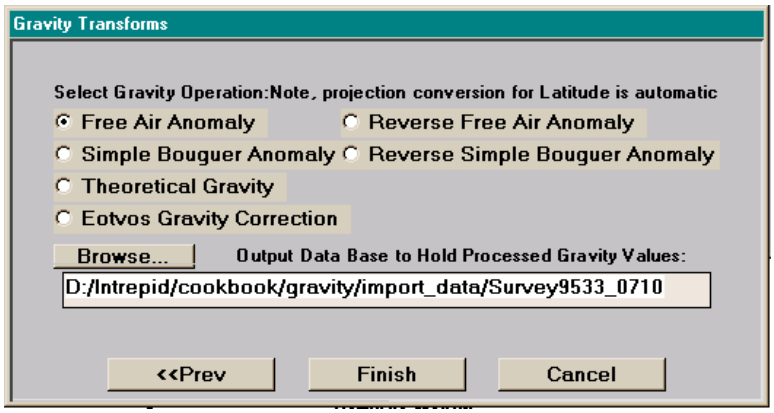
Use the reverse anomaly corrections to recreate an **obsgrav** field for a dataset that has only **FreeAir** or **Bouguer** fields.

Note: You automatically create the free air anomaly and the simple Bouguer anomaly when you reduce loop data to final.

To perform these corrections

1 Check that you have specified the appropriate datum and density settings (see "Gravity tool settings (T54b)" for details).

2 Choose Gravity Transforms from the Process menu.



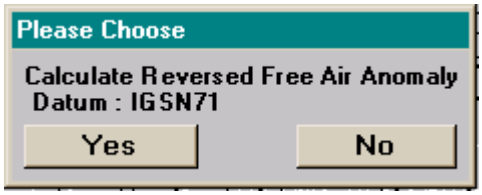
Specify the gravity point dataset for correction.

Select the correction that you require.

Choose Finish.

3 INTREPID prompts you for the required input and output fields (see below for details). INTREPID will not prompt for a field name if there is a corresponding valid alias.

4 INTREPID displays the current settings (if any) to use in the calculation.



If you wish to change the settings, choose No to cancel gravity correction and then modify the gravity settings as required (see "Gravity tool settings (T54b)" for details).

- To continue, choose Yes.
- To cancel, choose No.

INTREPID creates the new field in the gravity point dataset and appends a processing report to the current processing report file. If you have not specified a report file name during the current INTREPID session, it is named **`processing.rpt`** by default.

The processing report does not display automatically, but you can locate the file in the current directory.

You can

- View the processing report using a text editor.
- Use the Spreadsheet Editor to view the new field data.
- Use the Visualisation tool to view the data graphically.

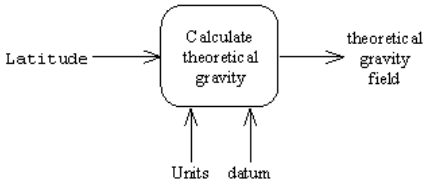
  Tip: *Assign the elevation field to point colour and the observed gravity or an anomaly field to point size.*

See Steps 2 and 3 of the complete Bouguer worked example in "Gravity field reduction and correction (C08)" for details.

Theoretical gravity

The theoretical gravity is a mathematical model of the earth's gravity field. It takes into account that the earth is an ellipsoid rather than a sphere. Each ellipsoid model has a corresponding gravity datum.

INTREPID uses the latitude and datum to create a new theoretical gravity field.



Input field	**`Latitude`**
Output field	Theoretical gravity (**`theograv`**)

INTREPID also automatically subtracts the theoretical gravity as one of the steps when it calculates the free air anomaly and simple Bouguer anomaly.

Sample processing report

```
Calculating theoretical gravity for all data base points
  ---------------------------------------------------

    Latitude field          : D:/Intrepid/cookbook/gravity/datasets/Survey9705/
Latitude
    Calculated gravity field: D:/Intrepid/cookbook/gravity/datasets/Survey9705/
theograv
    Gravity datum           : IGSN71
    Gravity units           : Milligals
```

To convert data reduced to a different ellipsoid:

You may want to merge two datasets that were reduced to different ellipsoids. If the datasets do not contain an observed gravity field you can use this option to revert to observed gravity for one of the datasets. You can then reduce the observed gravity to the required ellipsoid as usual.

1. From the Settings menu, select the datum that was used for the original reduction. Choose Theoretical Gravity to calculate the theoretical gravity that was subtracted from the observed gravity using this ellipsoid.
2. Use the spreadsheet editor to reapply (add) the theoretical gravity to the corrected gravity field to recreate the observed gravity field **obsgrav** .See Step 2 of the complete Bouguer worked example in "Gravity field reduction and correction (C08)" for an example of using the Spreadsheet tool.
3. Select your preferred datum from the Settings menu (for example WGS84). Calculate the theoretical gravity using this preferred datum.
4. Use the spreadsheet editor to subtract the revised theoretical gravity from the observed gravity.

Free air anomaly

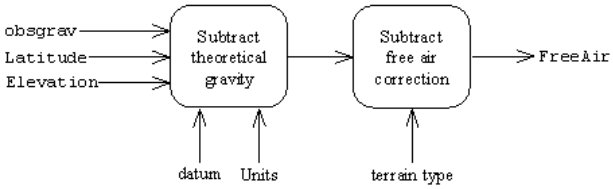
The free air correction compensates the observed gravity for the fact that it was measured at a given height above (or below) the datum.

It assumes, however, that there is nothing but air between sea level and the observation point.

INTREPID calculates the free air correction from the elevation and observed gravity fields and the terrain type.

The free air anomaly is calculated as follows:

`FreeAir = obsgrav -` theoretical gravity **-** free air correction



Input field	**`obsgrav, Latitude, Elevation`**
Output field	**`FreeAir`**

Free air correction formula

Here is the formula for free air correction using the full formula expressed as a vertical gradient. For IGSN71(GRS67) the formula is as follows (Robbins, 1981) and (Fils, Butt, Hawke, 1998) (See "Free air references" in Gravity references (R32)):

$\delta gh / \delta h = -2g_o/a[1 + f + m + (-3f + (5m)/2)\sin^2\phi] + (6g_o/a^2)*h$

where

g_o	= equatorial gravity on the ellipsoid = 9780318.456 μms^{-2}
f	= flattening coefficient = 1/298.25
a	= semi-major axis radius of the ellipsoid = 6378160 m
m	= centrifugal force at equator g_o = 0.0034498014
ϕ	= latitude
h	= height above ellipsoid

This can be expressed as:

Free Air correction
= $(3.08768 - 0.00440 \sin^2\phi)*h - 0.000001442*h^2$ μms^{-2} per metre;

Sample processing report

```
  Calculating Free Air Anomaly
  ----------------------------


    Observed gravity field  : D:/Intrepid/cookbook/gravity/datasets/Survey9705/
obsgrav
    Latitude field          : Survey9705/Latitude
    Station Elevation field : Survey9705/Elevation
    Meter   Elevation field : NO METER ELEVATION DATA BEING USED
    Output free air field   : D:/Intrepid/cookbook/gravity/datasets/Survey9705/
zzzz
    Gravity datum           : IGSN71
    Terrain type            : land
    Gravity units           : Milligals
```

Reverse free air anomaly

Use this correction when your data contains a free air anomaly field but no observed gravity field.

INTREPID adds the free air correction and the theoretical gravity to the free air anomaly field to recreate the observed gravity field.

obsgrav = FreeAir + free air correction **+** theoretical gravity

Input field	**FreeAir, Latitude, Elevation,**
Output field	**obsgrav**

Sample processing report

```
Reversing Free Air anomaly to observed gravity.
  ---------------------------------------------


    Free air gravity field  : D:/Intrepid/cookbook/gravity/datasets/Survey9705/
FreeAir
    Latitude field          : Survey9705/Latitude
    Station Elevation field : Survey9705/Elevation
    Meter   Elevation field : NO METER ELEVATION DATA BEING USED
    Output gravity field    : D:/Intrepid/cookbook/gravity/datasets/Survey9705/
obsgrav
    Gravity datum           : IGSN71
    Terrain type            : land
    Gravity units           : Milligals
```

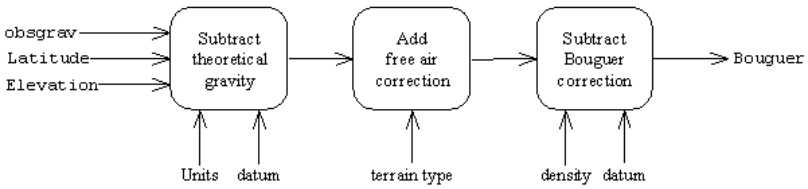
Simple Bouguer anomaly

The simple Bouguer correction replaces the "air" in the Free Air anomaly with rock.

INTREPID uses the observed gravity field and the specified density and datum settings to calculate the simple Bouguer correction.

The simple Bouguer anomaly is calculated as follows:

`Bouguer = obsgrav -` theoretical gravity **`-`** free air correction **`-`** simple Bouguer correction



Input field	**`obsgrav, Latitude, Elevation`**
Output field	**`FreeAir`**

You can experiment with different density settings to create a series of simple Bouguer anomaly fields; for example **`Bouguer267`**, **`Bouguer250`**, **`Bouguer200`** .

Sample processing report

```
Calculating Simple Bouguer Anomaly
 ---------------------------------


  Observed gravity field : D:/Intrepid/cookbook/gravity/import_data/
Survey9533_0710/Bouguer
  Latitude field     : D:/Intrepid/cookbook/gravity/import_data/Survey9533_0710/
Latitude
  Station Elevation field : D:/Intrepid/cookbook/gravity/import_data/
Survey9533_0710/Elevation
  Meter  Elevation field : NO METER ELEVATION DATA BEING USED
  Bouguer anomaly field  : D:/Intrepid/cookbook/gravity/import_data/
Survey9533_0710/Bouguer2
  Gravity datum      : IGSN71
  Terrain type      : land
  Density          : 2.670
  Gravity units      : Milligals
```

Reverse simple Bouguer anomaly

INTREPID calculates the observed gravity from the simple Bouguer gravity anomaly field.

obsgrav = Bouguer + simple Bouguer correction **+** free air correction **+** theoretical gravity

Input field	**Bouguer, Latitude, Elevation**
Output field	**obsgrav**

This is useful if you have data that is missing an observed gravity field and want to process it using different settings or corrections.

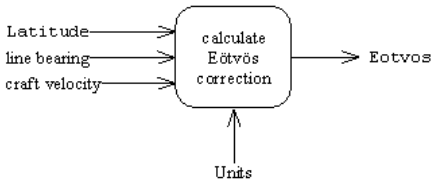
Sample processing report

```
Calculating Simple Bouguer Anomaly
Reversing Simple Bouguer anomaly to observed gravity
  ---------------------------------------------------


    Bouguer anomaly field   : D:/Intrepid/cookbook/gravity/datasets/Survey9705/
Bouguer
    Latitude field          : Survey9705/Latitude
    Station Elevation field : Survey9705/Elevation
    Meter   Elevation field : NO METER ELEVATION DATA BEING USED
    Output gravity field    : D:/Intrepid/cookbook/gravity/datasets/Survey9705/
obsgrav
    Gravity datum           : IGSN71
    Terrain type            : land
    Density                 : 2.670
    Gravity units           : Milligals
```

Eötvös gravity correction

Use this correction for marine and airborne survey data before reducing loop data to final. The correction compensates for measurements taken from a moving platform. It calculates the difference between the angular velocity of the observation platform and that of the rotating earth.



Input field	**Latitude,** line bearing and craft velocity fields
Output field	**Eotvos**

Tip: *INTREPID currently uses the simple velocity correction. We are developing a more complex method using cross correlation.*

Sample processing report

```
Calculating Eotvos gravity for all data base points
  ------------------------------------------------


    Latitude field         : D:/Intrepid/cookbook/gravity/datasets/Survey9705/
Latitude
    Line bearing field     : D:/Intrepid/cookbook/gravity/datasets/Survey9705/
bearing
    Craft velocity field   : D:/Intrepid/cookbook/gravity/datasets/Survey9705/
velocity
    Calculated Eotvos field: D:/Intrepid/cookbook/gravity/datasets/Survey9705/
Eotvos
    Gravity units          : Milligals
```

Applying the correction

Use the spreadsheet editor to subtract the Eötvös correction from the observed gravity field **obsgrav** to create a new observed gravity field.See "Complete Bouguer anomaly—worked example" in Gravity field reduction and correction (C08) for an example of using the Spreadsheet tool.

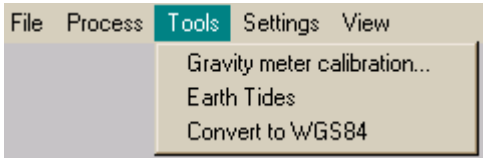
Other gravity operations

Gravity Wizard

Use this to start processing gravity data part way through the usual processing sequence.

Select Gravity Wizard from the Process menu.

Observed gravity adjustments and corrections



Gravity meter calibration

Datasets can contain calibration data. You can use this data to recalculate the scale factors for a gravimeter. Information about scale factors is included in Section 3 of the processing report. See "Gravimeter calibration (R29)" for details.

Select Gravity Meter Calibration from the Tools menu.

Specify the dataset that contains the calibration data.

Earth Tides

The Sun, moon and planets affect gravity at any place on the earth.

Use this to calculate the tidal corrections for a specified region of the Earth. INTREPID uses the Longman formula.

Select Earth Tides from the Tools menu.

Specify the location and time interval.

INTREPID automatically applies Earth tide corrections during the import process. Information about the Earth tide correction is included in Section 2 of the processing report.

Convert to WGS84

Use this to convert a gravity dataset to the WGS84 datum Specify the new gravity dataset name in the Specify Output Dataset dialog box.